NATIONAL DAIRY COUNCIL®

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January 23, 2009

Carol Davis
Co-Executive Secretary of the Dietary Guidelines Advisory Committee
Center of Nutrition for Policy and Promotion
U.S. Department of Agriculture
3101 Park Center Drive,
Room 1034
Alexandria, Virginia 22302

Announcement of the Second Meeting of the 2010 Dietary Guidelines Advisory Committee and Solicitation of Written Comments Federal Register, January 23, 2009 (Volume 74, Number 5)

Dear Ms. Davis:

The National Dairy Council (NDC) appreciates the opportunity to respond to the Federal Register Notice for written comments to the Dietary Guidelines Advisory Committee prior to its second meeting.

The NDC is a non-profit organization that initiates and administers nutrition research, develops nutrition education programs, and provides information on nutrition to health professionals and others concerned about good nutrition. The NDC has been a leader in nutrition research, education and communications since 1915. Through its affiliated Dairy Council units, the NDC is recognized throughout the nation as a leader in nutrition research, innovation and education. These programs were established and are funded by U. S. dairy farmers to help increase knowledge of the health benefits of milk and milk products in order to further the public health of the nation.

Nutrition Today is featuring a series of articles on relevant topics for the 2010 Dietary Guidelines, including most recently, an article on the Role of Dairy Foods in the Dietary Guidelines.[1] The purpose of the review article is to provide an understanding of the role of dairy foods in a healthy diet and to summarize new findings in areas of dairy and nutrition reviewed by the 2005 Dietary Guidelines Advisory Committee.

ROLE OF MILK PRODUCTS AND OVERALL NUTRIENT ADEQUACY

Dairy foods provide a unique nutrient-rich contribution to the diet and are a major or substantial contributor of key essential nutrients to the diet including calcium, potassium, phosphorus, magnesium, zinc, protein and vitamins A, D, and B12 and riboflavin.[1]

[1] Huth PJ, Fulgoni VL, DiRienzo DB, Miller GD. Role of Dairy Foods in the Dietary Guidelines. *Nutrition Today* 2008;43(6):226-234.

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The nutrient density of dairy foods goes beyond their contribution as the primary source of calcium. They are also the number one source of potassium, magnesium[2], phosphorus, and vitamin D in the diets of Americans (ages 2 through adults and the number one source of protein in the diets of children ages 2 to 11).[3] Dairy foods provide 83% of the calcium in the diets of young children, 77% in adolescent girls' diets, and between 65% and 72% in adults' diets.[4] Dairy foods provide 16% of the potassium and 14% of the magnesium in the U.S. diet. Calcium and potassium intakes are compromised if dairy foods are not included in the diet. [5,6] Currently, MyPyramid Eating Patterns do not meet the potassium requirements for any of the age/gender patterns. It is the contribution of potassium in dairy foods that help Americans boost potassium intake to 80% of the recommendation in the 1800 calorie meal pattern.[7,8] Milk and milk products also contribute other essential nutrients to the US diet, including riboflavin (25%), vitamin B12 (18%), protein (18%), zinc (15%), and vitamin A (11%).

Research to determine the feasibility of meeting calcium intake recommendations without dairy foods concluded that dairy-free diets cannot provide adequate calcium while still meet other macro- and micro-nutrient recommendations.[9] A USDA analysis conducted on behalf of the 2005 Dietary Guidelines Advisory Committee (DGAC) identified several nutrients beyond calcium for which milk products make a substantial contribution and for which nutrient shortfalls are created if milk products are not consumed.[6] The most widespread impacts from a lack of dairy products were on calcium and potassium, with decreases below the AI for almost all food intake patterns. Intakes of magnesium, phosphorus, and vitamin A were also negatively affected. Magnesium levels were low for all teen and adult men, and for many teen and adult women. Phosphorus levels were low for teen and preteen males and females, and for children age 2 to 3 years. Vitamin A levels were low for women age 50 and older.[6] Those who avoid milk should plan a strategy for replacing the nutrients contributed by milk or they are likely to fall short of recommendations for the nutrients highlighted above with special concern for calcium and potassium. The USDA did not attempt to develop eating patterns for replacement of milk products with other foods as part of its analysis. However, the USDA determined this would necessitate enormous deviations from typical food choices.[6] For example, an individual would need to eat almost seven cups of broccoli to consume

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[2] Cotton PA, Subar AF, Friday JE, Cook A. Dietary sources of nutrients among U.S. adults, 1994 to 1996. *J Am Diet Assoc* 2004;104:921-930. (online materials accessed January 8, 2009)

[3] Rafferty K, Heaney RP. Nutrient effects on the calcium economy: Emphasizing the potassium controversy. *J of Nutr 2008;138:166S-171S.*

[4] Fleming KH, HeimbachJT. Consumption of calcium in the US: food sources and intake levels. *J Nutr*. 1994; 124(8 suppl):1426S-1430S.

[5] United States. Dept. of Health and Human Services, United States. Dept. of Agriculture, and United States. Dietary Guidelines Advisory Committee, Dietary Guidelines for Americans, 2005. (6th ed. HHS publication. 2005, Washington, D.C.)

[6] http://www.health.gov/dietaryguidelines/dga2005/report/HTML/G2_Analyses.htm#nutrientcontrib

[7] Britten P, Marcoe K, Yamini S, Davis C. Development of food intake patterns for the MyPyramid Food Guidance System. *J Nutr Educ Behav*. 2006;38:S78-S92.

[8] McGill, CR, Fulgoni V, DiRienzo D, Huth PJ, Kurilich AC, Miller GD. Contribution of dairy products to dietary potassium intake in the United States population. *J Am Coll Nutr*. 2008;27:44-50.

[9] Gao X,Wilde PE, Lichtenstein AH, Tucker KL.Meeting adequate intake for dietary calcium without dairy foods in adolescents aged 9Y18 years (National Health and Nutrition Examination Survey 2001Y2002). *J Am Diet Assoc*. 2006;106:1759Y1765.

the calcium provided by three servings of milk, cheese or yogurt, without taking into account the other essential nutrients dairy provides.

For those who may be lactose intolerant, there are many options in the dairy aisle—lactose-free milks, yogurts, and hard cheeses. It makes nutrition sense that the Dietary Guidelines recommend *all* people consume at least three servings of dairy each day. The same unique nutrient package found in regular milk is also present in lactose-reduced or lactose-free milk products. Similar recommendations for keeping dairy foods in the diet of lactose intolerant children have been made by the American Academy of Pediatrics.[10]

Dairy's nutrient package includes four of the seven nutrients of concern for adults, as identified by the 2005 Dietary Guidelines, including calcium, potassium, magnesium and vitamin A.

While milk and milk products provide significant amount of nutrients essential for growth and development, too many children and adolescents today fail to get enough of these nutrients. The 2005 Dietary Guidelines identifies five nutrients of concern for children and adolescents: calcium, potassium, fiber, magnesium and vitamin E. Dairy supplies three of the five: calcium, potassium, and magnesium.

The nutrient shortfalls seen in the diets of children and adolescents may be attributed, at least in part, to changes in the food consumption patterns of the US population overall. After the age of 8 years, the intake of soft drinks increases dramatically, while milk consumption drops (Figure 1).[11,12] Figure 1 shows that after the age of 8 and through age 18, adolescents drink approximately 19 ounces of soft drinks per day, whereas milk consumption decreases to less than 8 ounces per day.[1] Delivering on taste is #1 for children and adolescents, and milk, flavored and unflavored, delivers taste along with several nutrients essential for growth and development. These years represent a period of rapid skeletal growth, and present a critical "window of opportunity" to maximize peak bone mass and protect the skeleton against future risk of osteoporosis.

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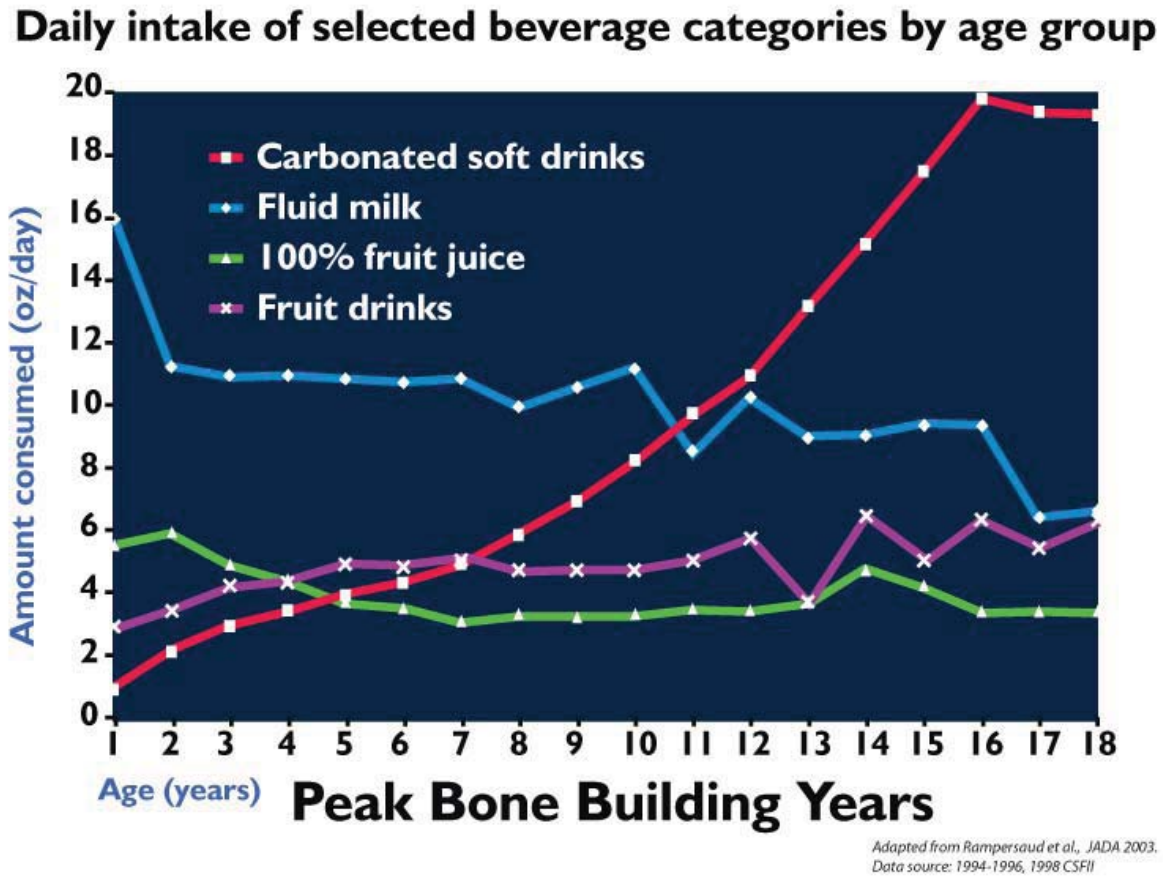
[10] Heyman MB, for the Committee for Nutrition. Lactose intolerance in infants, children, and adolescents. *Pediatrics* 2006;118(3):1279-1286.

[11] Nicklas TA. Calcium intake trends and health consequences from childhood through adulthood. *J Am Coll Nutr*. 2003;22(5):340Y356

[12] Rampersaud GC, Bailey LB, Kauwell GM. National survey beverage consumption data for children and adolescents indicate the need to encourage a shift toward more nutritive beverages. *J Am Diet Assoc*. 2003;27:44Y50.

Figure 1.



ASSESSING THE OPTIMAL NUMBER OF DAIRY SERVINGS FOR AMERICANS

Dairy foods are nutrient-dense and the scientific evidence continues to mount regarding the need for adequate intake of dairy foods every day. A diet that provides 3-4 servings/day helps to ensure adequate intakes of calcium, magnesium, and potassium for individuals 9 years of age or older, according to an analysis of NHANES data.[13] This is also consistent with recommendations from the American Heart Association[14], the American Academy of Pediatrics[15], the National Medical Association[16], and the Surgeon General.[17] Additional leading health authorities including the

[13] Fulgoni VL, Zaripheh S, Huth PJ, DiRienzo DB, Miller GD. Usual intake of vitamin A, calcium, magnesium, phosphorus and potassium from NHANES (2003-2004). *FASEB J*. 2008;22:1081-1085.

[14] American Heart Association, Gidding S S, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichtenstein AH, Thomas Rattay K, Steinberger J, Stettler, N and Van Horn L Dietary Recommendations for Children and Adolescents: A Guide for Practitioners *Pediatrics* 2006; 117;544-559

[15] Greer FR, Krebs NF, and Committee on Nutrition Optimizing Bone Health and Calcium Intakes of Infants, Children, and Adolescents *Pediatrics* 2006; 117;578-585

[16] Wooten WJ, Price W Consensus Report of the National Medical Association The Role of Dairy and Dairy Nutrient in the Diet of African Americans *J National Medical Association* 2004, Suppl: 96; 12

[17] US Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: US Department of Health and Human Services, Office of the Surgeon General; 2004:57

American Academy of Family Physicians[18], American Dietetic Association[19] and the School Nutrition Association[20] recognize the important contribution that at least 3 servings a day of low-fat or fat-free dairy foods provide to a healthy diet.

The National Health and Nutrition Examination Survey (NHANES) 2001-2002 reported that the dietary reference intakes (DRIs) for calcium, magnesium, and potassium, in certain age groups, do not meet the recommended levels set forth by the Institutes of Medicine (IOM). Approximately 70% of the population age 1 or older do not meet the recommended level of calcium; 56% consume less than the estimated average requirement (EAR) for magnesium, and almost all of the population does not consume the recommended levels of potassium.[21]

Using the NHANES data, a study was undertaken to estimate the optimal number of dairy servings in a mixed diet needed for adequate intake of calcium and magnesium.[13] The study showed that about 2 dairy servings per day are necessary for children ages 2-8 to meet or exceed the DRIs for calcium and magnesium. Children ages 9-18 were estimated to need 3-4 dairy servings per day to meet calcium recommendations and at least 4 daily dairy servings to meet magnesium recommendations. Adults ages 19-50 needed at least 3 dairy servings per day of dairy (2 to meet calcium recommendations and at least 3 to meet magnesium recommendations). Adults older than age 51 needed an average of 3 servings a day to meet calcium recommendations and at least 4 servings a day to meet magnesium recommendations. In an analysis of the contribution of dairy products to potassium intake, mean potassium intakes were significantly greater in participants whose diets met dairy intake recommendations.[8] Mean intakes however, did not meet the adequate intake (AI) for any age groups in this analysis. The 2005 DGAC identified the milk group as the major contributor of potassium at most calorie levels. The 2005 Committee's analysis also found that achieving the recommended intakes for potassium and calcium could not be reached for most calorie levels until the food patterns were adjusted to include 3 cups of milk or three servings of milk products per day.[22]

Taken together, the data indicate that 3-4 servings from the milk group should be consumed each day for individuals ages 9 and up to ensure adequate intakes of calcium, magnesium and potassium.

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[18] Garber SD Fleming M and Olendzki B Nutrition Guidelines for Better Health CME Bulletin 2008;7;1

[19] Position of the American Dietetic Association: Nutrition Guidance for Healthy Children Ages 2 to 11 Years *J Am Diet Assoc.* 2008;108:1038-1047.

[20] http://www.schoolnutrition.org/uploadedFiles/School_Nutrition/16_LegislativeAction/SNA_National_Nutrition_Standards.pdf

[21] Mosfegh A, Goldman J, Cleveland L. What we eat in America, NSANES 2001-2002. Usual nutrient intake from foods as compared to dietary reference intakes. 2005. US Department of Agriculture, Agricultural Research Service. http://www.ars.usda.gov/SP2UserFiles/Place/12355000/pdf/usualintaketables2001-02.pdf. Accessed October 24, 2008.

[22] 2005 Dietary Guidelines Advisory Committee report, http://www.health.gov/dietaryguidelines. Accessed October 24, 2008.

IMPACT OF MILK PRODUCTS ON CHRONIC DISEASE RISK

MILK PRODUCTS, BONE HEALTH, AND OSTEOPOROSIS

There is strong and consistent evidence that diets containing adequate levels of calcium and vitamin D are protective against low bone mass and osteoporosis.[23] FDA recently approved a new health claim for vitamin D and calcium: *Adequate calcium and vitamin, D as part of a healthful diet, along with physical activity, may reduce the risk of osteoporosis in later life*.[24] Dairy's nutrient package includes calcium and vitamin D. According to the Surgeon General's report, *Bone Health and Osteoporosis* (2004), other nutrients found in dairy foods, beyond calcium and vitamin D, are critical to bone health, including phosphorus, protein, potassium, magnesium, zinc, and vitamin A.[17] Future studies on the prevention of fractures should focus on defining the optimal combination of calcium and vitamin D, which, when taken together, are effective in reducing fracture risk.[1]

MILK PRODUCTS AND BLOOD PRESSURE

Lifestyle changes, including diet, are an important part of any plan to achieve and maintain a healthy blood pressure. Dairy foods, an integral part of the National Institutes of Health Dietary Approaches to Stop Hypertension eating plan (also known as DASH), play an important role in healthy blood pressure.[25,26] Research shows the low-fat DASH eating plan, which includes two to three servings of mostly low-fat dairy foods and eight to ten servings of fruits and vegetables a day, may help lower blood pressure. The DASH eating plan produced greater reductions in systolic blood pressure and diastolic blood pressure than either a diet high in only fruits and vegetables or the control diet.[26] The DASH diet was twice as effective at lowering systolic blood pressure among African-Americans as in Caucasians.[27]

Potassium is known to be a blood pressure regulator—but it is not widely appreciated that a potassium-rich diet blunts the effects of sodium on blood pressure.[5] With milk providing the number one source of potassium in the American diet,[2,3] it is understandable that DASH researchers see better results when dairy intake is higher.

According to the Centers for Disease Control and Prevention, an estimated 17% of American children are either overweight or obese.[28] These children are at significantly greater risk of developing high blood pressure in adulthood. The DASH Eating Plan is encouraged as one of the

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[23] US Department of Health and Human Services. *Bone Health and Osteoporosis: A Report of the Surgeon General*. Rockville, MD: US Department of Health and Human Services, Office of the Surgeon General; 2004:57

[24] http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?c=ecfr;rgn=div2;view=text;node=20080929%3A1.3;idno=21;sid=aa9660c9f015fdbfa0bcdaa733bb8e48;cc=ecfr;start=1;size=25

[25] U.S. Department of Health and Human Services, National Institutes of Health, National Heart, Lung, and Blood Institute. *Your Guide to Lowering Your Blood Pressure With DASH*. NIH Publication No. 06-4082, 2006.

[26] Appel L, Moore T, Obarzanek E, Vollmer W, Svetkey L, Sacks F, Bray G, Vogt T, Cutler J, Windhauswer M, Lin P, Karanja N. A clinical trial of the effects of dietary patterns on blood pressure. DASH Collaborative Research Group. *New Eng J Med.* 336;16: 1117-24, 1997.

[27] Svetkey LP, et al. Effects of dietary patterns on blood pressure. Subgroup analysis of the Dietary Approaches to Stop Hypertension (DASH) randomized clinical trial. *Arch Intl Med*. 1999; 159:285-93.

[28] Ogden C, Carroll M, Curtin L, McDowell M, Tabak C, Flegal K. Prevalence of overweight and obesity in the United States, 1999-2004. J Am Med Assoc 2006;295:1549-55.

lifestyle modifications to help prevent and control high blood pressure in children.[29] The Framingham Children's Study, showed that children who consumed 2 or more servings a day of milk and dairy products during preschool years, regardless of fat content, had smaller yearly gains in systolic blood pressure and lower systolic blood pressure by early adolescence.[29] A DASH-type diet, rich in fruits, vegetables and low-fat dairy foods, was more effective than routine outpatient care at improving systolic blood pressure and diet quality in adolescents with elevated blood pressure.[30]

POSITIVE DIETARY GUIDANCE

To help prevent chronic disease and promote health, NDC promotes the concept of providing positive advice to Americans about what to eat, such as that provided in the 2005 Dietary Guidelines, by identifying food groups to encourage—low-fat and fat-free dairy foods, fruits, vegetables, and whole grains.

Dairy foods, which provide substantial amounts of several essential nutrients for the amount of calories and for an economically low price, play a critical role in developing healthful eating patterns that meets the objectives of the Dietary Guidelines for nutrient adequacy and may help prevent chronic diseases.

The National Dairy Council appreciates this opportunity to provide comments to the Dietary Guidelines Advisory Committee as the Committee continues its important work. As a science-based organization, please consider the NDC as a resource ready to support the work on healthy diets, especially as it relates to scientific perspective on nutrient-rich dairy foods.

Sincerely,

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Executive Vice President
Research, Regulatory and Scientific Affairs
DMI/National Dairy Council

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[29] Moore LL, Singer MR, Bradlee ML, et al. Intake of fruits, vegetables, and dairy products in early childhood and subsequent blood pressure change. *Epidemiology*. 2005;16(1):4Y11.

[30] SC Couch, BE Saelens, L Levin, K Dart, G Falciglia, and SR Daniels. The efficacy of a clinic-based behavioral nutrition intervention emphasizing a DASH-type diet for adolescents with elevated blood pressure. *J Pediatr*. 2008; 152: 494.

Role of Dairy Foods in the Dietary Guidelines

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Victor L. Fulgoni III, PhD
Douglas B. DiRienzo, PhD, FACN
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Dairy product consumption is associated with overall diet quality and adequate intake of nutrients, including calcium, phosphorus, potassium, magnesium, zinc, iron, vitamin B_{12}, protein, riboflavin, and vitamins A and D. This article provides evidence that milk and milk products play a critical role in planning eating patterns that conform to the *Dietary Guidelines for Americans* for nutrient adequacy and may help reduce risk of some chronic diseases. Nutr Today. 2008;43(6):226–234

The *Dietary Guidelines for Americans* (DGA) provides science-based advice to promote health and reduce risk for major chronic diseases through diet and physical activity.[1] The premise of the DGA is that, in most cases, nutrient needs should be met primarily through conventional foods and healthful eating patterns such as the US Department of Agriculture's (USDA's) MyPyramid Food Guidance System (MyPyramid) or the Dietary Approaches to Stop Hypertension (DASH) Eating Plan. These eating plans provide suggested amounts of nutrient-rich foods from the primary food groups: fruits, vegetables, dairy, meat and beans, grains, and fats and oils, that, when consumed at recommended amounts, will supply adequate amount of all essential nutrients within calorie needs. The purpose of this review is to provide an understanding of the role of dairy foods in a healthy diet and to summarize new findings in areas of dairy and nutrition reviewed by the 2005 Dietary Guidelines Advisory Committee (DGAC).[2] Although some important areas are beyond the scope of this review, including dairy and cancer and lactose intolerance, readers are referred to excellent reviews of these areas.[3,4]

Role of Milk Products and Overall Nutrient Adequacy

Despite the highly adequate food supply in the United States, 7 nutrients have been identified by the DGAC[2] as "nutrients of concern" that warrant increased intakes, including the following:

- For adults: vitamins A, C, and E; calcium; magnesium; potassium; and fiber
- For children: vitamin E, calcium, magnesium, potassium, and fiber

Dairy foods contribute significant amounts to 4 of the 7 and 3 of the 5 nutrients of concern for adults and children, respectively, including calcium, potassium, magnesium, and vitamin A. Dairy products provide 83% of the calcium in the diets of young children, 77% in adolescent girls' diets, and between 65% and 72% in adults' diets.[5] Pragmatically, it is difficult to achieve dietary calcium recommendations without consuming dairy products. Milk and milk products also contribute other essential nutrients to the US diet, including phosphorus (30%), riboflavin (25%), vitamin B_{12} (18%), protein (18%), potassium (16%), zinc (15%), magnesium (14%), and vitamin A (11%) (Table 1). Vitamin D–fortified milk products provide a major source of the US dietary intake of vitamin D.

There is little disagreement about the public health benefits of adequate calcium intake. The major concern in the United States is how to best meet calcium needs. Unfortunately, most Americans are not meeting the dietary recommendations for calcium, particularly in young and adolescent girls and older adults. The "calcium crisis" may be attributed, at least in part, to changes in the food consumption patterns of the US population, in particular the trend toward consuming less milk and more soft drinks.[6,7] After the age of 8 years, the intake of soft drinks increases dramatically, and by the age of 18 years, adolescents drink approximately

Table 1. Percentage of Nutrient Contribution of Dairy Foods, Excluding Butter, to the US Food Supply, 2005

Nutrient	Percentage
Energy	7.6
Protein	18.1
Fat	8.3
Saturated fat	16.6
Cholesterol	12.5
Carbohydrate	4.3
Minerals	
Calcium	70.3
Phosphorus	30.1
Zinc	15.0
Magnesium	13.9
Iron	1.8
Potassium	16.0
Sodium	33.2
Vitamins	
Riboflavin	25.0
Vitamin B_{12}	18.2
Vitamin A	10.7
Vitamin B_6	6.8
Folate	3.3
Thiamin	4.3
Vitamin E	1.7
Ascorbic acid	2.5
Niacin	1.1

Data from MyPyramid.Gov. Steps to a Healthier You. Food Supply Database. US Department of Agriculture, Center for Nutrition Policy and Promotion (http://65.216.150.148/ifs/Query.htm).

19 oz/d whereas milk consumption decreases to less than 1 serving per day (Figure 1).[7] Surveys by the USDA indicate that Americans older than 2 years consumed an average of 1.7 servings per day of dairy foods instead of the 2 to 3 servings per day currently recommended by the USDA's MyPyramid.[8]

Gao et al[9] have modeled diets to determine the practical feasibility of meeting calcium intake recommendations without dairy products, concluding that although it is certainly feasible to meet calcium intakes through the use of calcium-fortified foods, adequate calcium intake cannot be met with dairy-free diets while still meeting recommendations of other macronutrients and micronutrients within typical US dietary patterns. Those who avoid milk must plan a strategy for replacing the nutrients contributed by milk or they are likely to fall short of the recommendations for calcium and other nutrients. Bioavailability and amount of calcium per serving both need to be considered in evaluating alternative food choices, as do the contributions of other nutrients that 3 servings of milk would provide.

Assessing the Optimal Number of Dairy Servings for Americans

The Institute of Medicine reevaluated nutrient requirements for macronutrients and micronutrients, including vitamins and minerals, for various age/sex groups that led to the development of dietary reference intakes (DRIs).[10] Table 2 shows the DRI for calcium, magnesium, and potassium for various age groups and the percentage of the population not meeting recommended levels as reported from the National Health and Nutrition Examination Survey 2001–2002. Approximately 70% of the US population 1 year or older are not obtaining the recommended level of calcium, and more than 56% consume less than the estimated average requirement for magnesium, whereas almost all of the population are not consuming the recommended level of potassium. Recently, Fulgoni et al,[11] using nutrient intake data from National Health and Nutrition Examination Survey 1999–2004, examined the dietary intake of calcium, magnesium, and potassium by various levels of dairy consumption to estimate the optimal number of dairy servings necessary in a mixed diet to ensure a high prevalence of adequate intake for calcium and magnesium (Table 3). About 2 servings per day were necessary for children 2 to 8 years of age to meet or exceed the DRI for calcium and magnesium of this group. Children 9 to 18 years of age needed an average of 4 servings per day (3 to meet calcium recommendations and at least 4 to meet magnesium recommendations). Adults 19 to 50 years of age needed at least 3 servings per day of dairy (2 to

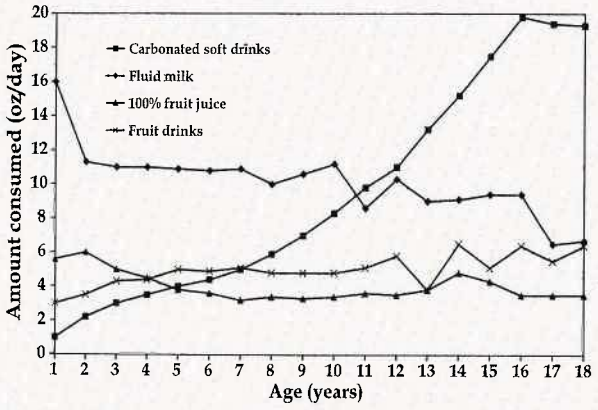

Figure 1. Daily intake of selected beverage categories by age group[7] (mean and SEM).

Table 2. Dietary Reference Intakes for Calcium, Magnesium, and Potassium (mg/d) and Percentage of US Population Not Meeting Recommended Intakes (%)

Ages, y	Calcium AI	Magnesium EAR	Potassium AI
Males and Females			
1–3	500 (6%)	80 (<3%)	3,000 (94%)
4–8	800 (31)	130 (<3)	3,800 (>97)
Females			
9–13	1,300 (94)	240 (44)	4,500 (>97)
14–18	1,300 (91)	360 (91)	4,700 (>97)
19–30	1,000 (79)	310 (64)	4,700 (>97)
31–50	1,000 (85)	320 (65)	4,700 (>97)
51–70	1,200 (95)	320 (64)	4,700 (>97)
>70	1,200 (96)	320 (82)	4,700 (>97)
Males			
9–13	1,300 (72)	240 (14)	4,500 (>97)
14–18	1,300 (69)	410 (78)	4,700 (>97)
19–30	1,000 (47)	400 (55)	4,700 (95)
31–50	1,000 (54)	420 (61)	4,700 (95)
51–70	1,200 (84)	420 (70)	4,700 (94)
>70	1,200 (88)	420 (81)	4,700 (>97)
All persons >1 y	(70)	(56)	(>97)

Abbreviations: AI, Adequate Intake; EAR, Estimated Average Requirement. Data from Mosfegh et al.[33]

meet calcium recommendations and at least 3 to meet magnesium recommendations). Adults older than 51 years needed an average of 4 servings per day of dairy (3 to meet calcium recommendations and at least 4 to meet magnesium recommendations).[11] In a separate analysis on the contribution of dairy products to potassium intake, mean potassium intakes were significantly greater in participants whose diet met dairy intake recommendations.[12] Mean intakes, however, did not meet the AI for any age groups in this analysis. The DGAC found through the use of food pattern modeling that the milk group is the major contributor of potassium at most calorie levels and that achieving the recommended intakes for potassium and calcium could not be reached for most calorie levels until the food patterns were adjusted to include 3 cups of milk or milk products per day.[2]

Taken together, these data indicate that 3 to 4 servings from the milk group for all individuals older than 9 years is important to ensure adequate intakes of calcium and magnesium and to contribute important amounts of potassium.

What Is the Impact of Milk Products on Chronic Disease Risk?

The 2005 DGA recommended an increase in dairy servings from the 2 to 3 servings per day recommended by the previous *Dietary Guidelines* (2000) to a uniform 3 servings per day for Americans older than 9 years. This was based on evidence showing the value of dairy for improving the dietary intake of essential nutrients through conventional foods and for reducing the risk of low bone mass and on emerging evidence suggesting that dairy foods may have other health-related benefits.[2]

Milk Products, Bone Health, and Osteoporosis

In a review of the randomized clinical trials (RCTs) and observational studies evaluating the quantitative impact of dairy products on bone health, 7 of 7 RCTs and 25 of 32 observational studies showed a significant positive impact of dairy food consumption on bone mineral content (BMC) or bone mineral density (BMD) in 1 or more skeletal sites (Appendix G3).[2] More recently, 4 additional RCTs have reported the impact of dairy foods on BMD and BMC in children[13–15] and in postmenopausal women[16]—all showed significant positive effects on bone mineralization.

The effects of calcium supplementation alone on bone density in children have been summarized in a meta-analysis of 19 RCTs that showed no effect of calcium supplementation on BMD at the femoral neck or lumbar spine and a small effect on total body BMC and upper limb BMD.[17] Because many of the RCTs used in this analysis did not have a low-calcium-intake control group, this may have, in part, accounted for these results. Like many other nutrients, calcium exhibits threshold behavior; that is, effects increase up to a certain threshold value, above which further increases in intake produce little additional effect.[18] Studies without a low-calcium-intake contrast group are not capable of testing whether calcium produces skeletal benefits. Thus, meta-analyses of published trials need to use the presence of a low-calcium-intake group as a criterion for inclusion in the analysis. This is consistent with a recent meta-analysis showing that increased dietary calcium/dairy supplementation, with and without vitamin D, significantly increased total body and lumbar spine BMC in children with low baseline intakes whereas no effect was observed when studies that had normal or near-normal baseline calcium intakes were included.[19] In the only long-term placebo-controlled RCT of calcium supplementation, spanning 7 years from childhood to young adulthood in females, calcium supplementation

Table 3. Calcium, Magnesium, and Potassium Intake and Percentage Meeting DRIs by Dairy Servings

	No. of Dairy Servings Consumed					
	<1	1–1.5	1.5–2.5	2.5–3.5	3.5–4.5	>4.5
Children, 2–8 y						
Dairy consumption, servings/d	0.48	1.24	1.97	2.93	3.94	5.77
Calcium, % AI	54	81	108	146	183	252
Magnesium, % RDA	135	156	179	215	227	282
Potassium, % AI	43	52	58	70	77	97
Children, 9–18 y						
Dairy consumption, servings/d	0.40	1.23	1.97	2.94	3.94	6.25
Calcium, % AI	32	53	71	97	121	180
Magnesium, % RDA	56	64	74	89	97	130
Potassium, % AI	38	43	49	59	65	89
Adults, 19–50 y						
Dairy consumption, servings/d	0.36	1.24	1.95	2.95	3.95	6.41
Calcium, % AI	47	75	101	134	167	247
Magnesium, % RDA	67	76	85	95	108	133
Potassium, % AI	48	55	62	68	78	97
Adults >51 y						
Dairy consumption, servings/d	0.36	1.23	1.95	2.91	3.88	5.95
Calcium, % AI	38	61	81	107	133	186
Magnesium, % RDA	62	73	81	92	103	124
Potassium, % AI	49	57	62	71	79	98

Abbreviations: AI, Adequate Intake; DRI, Dietary Reference Intake; RDA, Recommended Dietary Allowance.
Adapted from Fulgoni et al[11] and McGill et al.[12]

resulted in significantly greater bone accretion during the pubertal growth spurt whereas the effects diminished thereafter with time.[20] By young adulthood (year 7 end point), significant effects of calcium supplementation remained only in participants who developed larger body frames and had better calcium compliance. In other studies evaluating the nutritional influences on skeletal health, bone status was found to be significantly improved in participants with higher intakes of potassium, magnesium, and zinc, as well as calcium.[21] The Surgeon General's report in *Bone Health and Osteoporosis* (2004) also recognized that in addition to calcium and vitamin D, other nutrients are critical to bone health, including phosphorus, protein, potassium, magnesium, zinc, vitamin A, and vitamin C.[22] In older adults, the strongest outcome measure for bone health is fracture incidence. The DGAC report pointed out that 5 of 8 observational studies found milk product consumption to be significantly associated with reduced fracture risk (Appendix G3).[2] To date, however, no RCTs have evaluated the impact of dairy foods on fracture risk. That said, at least 6 RCTs have reported significant fracture reduction with increased elemental calcium[23–25] or calcium plus vitamin D intake.[26–28] In contrast, a recent meta-analysis of epidemiological studies and clinical studies suggested that calcium supplementation alone is not significantly associated with hip fracture risk in women or men.[29] On the other hand, several RCTs have evaluated the combined effect of calcium and vitamin D on fracture risk and have been summarized in2 meta-analyses showing that oral vitamin D appears to modestly, but significantly, reduce the risk of hip fractures only when combined with calcium supplementation (relative risk [RR], 0.81; 95% confidence interval [CI], 0.68–0.96; and RR, 0.82; 95% CI, 0.71–0.94, respectively).[30,31] Pooled data from these studies indicated that administration of 700 to 800 IU of vitamin D_3 with coadministration of 1,000 to 1,200 mg calcium was effective. Taken together, future studies on the prevention of fractures should focus on defining the optimal combination of calcium and vitamin D. Furthermore, because calcium carbonate or calcium citrate malate can reduce phosphorous absorption, which may be detrimental,[32] because of the balanced ratio of calcium to phosphate that is needed for bone mineralization, and because only about 50% of females aged 9 to 18 years have adequate phosphorus intakes,[33] it is important to understand the significance of potential phosphate deficiency and its correction by using conventional foods that are the primary dietary sources

of both calcium and phosphorus (eg, dairy foods) or by using calcium phosphate supplements.

Milk Products and Insulin Resistance Syndrome

An emerging body of evidence suggests that dairy product consumption and its components, calcium and vitamin D, may be associated with a decreased risk of insulin resistance syndrome (IRS) and type 2 diabetes (t2DM), also known as metabolic syndrome or syndrome X.[34] The components of IRS include abdominal obesity, hypertension, dyslipidemia, insulin resistance, and hyperinsulinemia, which are well-established risk factors for cardiovascular disease and t2DM. Sixty million people in the United States have IRS, and 1 in 4 will go on to develop t2DM.

The 2005 DGAC reviewed the evidence on the relationship between dairy product consumption and IRS and concluded that the data are limited but provocative and warrant further research to better understand the role of dairy products and their constituents.[2] Several cross-sectional and prospective observational studies have shown a relatively consistent inverse relationship between dairy food intake and IRS or t2DM, and this evidence has been summarized in a recent meta-analysis.[34] Their analysis of cross-sectional studies showed an inverse relationship between dairy and the prevalence of IRS (odds ratio [OR], 0.71; 95% CI, 0.57–0.89 for the highest vs lowest dairy intake, ie, 3–4 vs 0.9–1.7 servings per day). Prospective studies also showed a modest inverse association of dairy intake with the incidence of t2DM or IRS (OR, 0.86; 95% CI, 0.79–0.93) for the highest versus lowest dairy intake (ie, 3–5 vs <1.5 servings per day). Results from more recent observational studies have shown a significant inverse relationship between total dairy food consumption and the prevalence[35,36] and incidence[37] of IRS, whereas other results have shown no effect of milk intake alone[35] or total dairy intake[38] on incident of t2DM or risk of developing IRS, respectively. Although it is tempting to ascribe these findings to the calcium and vitamin D components of dairy, their contribution cannot be separated from other components of dairy. That said, evidence from observational studies suggests an association between low vitamin D intake, low plasma 25-hydroxyvitamin D (25-OHD), and low calcium and dairy intake and risk of t2DM or IRS.[34] In the Nurses Health Study, women with the highest combined calcium (>1,200 mg/d) and vitamin D (>800 IU/d) intake had a 33% lower risk of t2DM compared with those with the lowest intakes (<400 mg/d and <400 IU/d, respectively).[39] Because the major dietary source of vitamin D and calcium is dairy foods, in a separate analysis, the risk of t2DM was shown to be 11% lower in women who consumed 3 or more servings per day versus those who consumed less than 1 serving per day of dairy food (RR, 0.89; 95% CI, 0.81–0.99; $P_{trend} = 0.008$).

Clinical evidence on calcium supplementation alone or dairy products on diabetes-related biomarkers have been limited to studies with small numbers of participants without diabetes, and results on glycemic and insulin resistance have been conflicting, but most have shown no effect.[40–44] The effects of calcium plus vitamin D supplementation on t2DM were reported in a post hoc analysis of an RCT originally designed for bone-related outcomes, showing that in older adults receiving a combination of 500 mg/d calcium citrate and 700 IU/d vitamin D_3 for 3 years, resulted in a lower rise in fasting plasma glucose and lower insulin resistance (estimated by HOMA-IR) in participants with impaired fasting glucose compared with placebo whereas no effect was observed in those with normal fasting glucose.[45]

Although there seems to be an association of inadequate vitamin D, calcium status and low dairy intake with t2DM and IRS, the data are limited. There is a need for prospective cohort studies to quantify the relationship between calcium and dairy intake and plasma 25-OHD levels and IRS and t2DM risk. There is also a need for RCTs with calcium, vitamin D, and/or dairy to assess their independent effects on glycemic and insulin-related surrogate markers of IRS and t2DM.

Coronary Heart Disease

In related work on the relationship between dairy and coronary heart disease (CHD), an analysis of 10 prospective cohort studies relating milk intake at baseline to vascular disease events resulted in a pooled estimate of relative risk for heart disease of less than one in subjects with the highest intakes of milk compared to the lowest consumption, OR = 0.84 (95% CI, 0.78–0.90) for any vascular event and 0.87 (95% CI, 0.74–1.03) for ischemic heart disease.[46] When 2,403 men were followed for 20 to 24 years and data on milk intake and incidence of ischemic stroke were obtained, the hazard ratio (HR) for ischemic stroke in those who consumed 2 or more cups of milk per day, compared with those who did not consume milk, was less than one, HR = 0.64 (95% CI, 0.39–1.06).[47] The HR was 0.37 (95% CI, 0.15–0.90) in those who had experienced a prior vascular event. Systolic blood pressure (SBP) was slightly lower in the men who consumed milk (P_{trend} <0.02), and no elevations in total cholesterol or triglyceride levels were observed. The authors suggested that most of the participants consumed whole milk for most of the study period, but this is unclear. Although one cannot draw causal relationships from these studies, it does show the lack of convincing evidence that milk consumption is associated with increased risk of ischemic heart disease. In contrast, not all studies are consistent with this conclusion.[48,49] The Nurses Health Study reported that

among the types of dairy products, whole-milk consumption was associated with increased risk of CHD (RR, 1.67; 95% CI, 1.14–1.90; P for trend < 0.0001). Skim milk was associated with a nonsignificantly lower risk of CHD (RR, 0.78; 95% CI, 0.63-0.96; $P_{trend} = 0.09$), whereas when all high-fat dairy products were considered (whole milk, hard and cream cheese, ice cream, and butter) and after multivariate adjustment, no significant association with CHD risk was observed (RR, 1.08; $P_{trend} = 0.33$).[49]

Blood Pressure

A considerable database of observational trials and RCTs exists regarding the effects of dairy food consumption and calcium supplementation on blood pressure (BP) and the risk of hypertension (one component of IRS).[50–58] Observational studies in children,[51] young adults,[52,53] and mature adults[54,55] have been relatively consistent with results that suggest an inverse association between dairy food consumption and BP or risk of hypertension. In the Framingham Children's study, children who consumed 2 or more servings per day of dairy products during preschool years, regardless of product fat level, had smaller yearly gains in SBP and lower SBP by early adolescence.[51] In the CARDIA study, in overweight young adults followed for 10 years, consumption of reduced fat and higher fat dairy products was inversely associated with the risk of high BP.[52] In contrast, the highest quintile of low-fat dairy intake in a cohort of 5,880 Spanish adults was associated with a 54% reduction in hypertension risk, whereas no effect was observed with higher fat dairy.[54] Similarly, increasing intakes of low-fat dairy but not higher fat dairy products were inversely associated with risk of hypertension in middle-aged and older women.[55] This study also showed that food-derived calcium and vitamin D (but not supplemental sources) were each inversely associated with risk of hypertension.

Clinical evidence for an independent BP-lowering effect of dairy products is limited. However, the potential effects of dairy consumption on BP control have been consistently demonstrated in the DASH studies.[56–58] In a DASH combination diet, low in fat and saturated fat and enriched in calcium, potassium, and magnesium, containing 3 servings per day of mostly low-fat dairy products and high in fruits and vegetables (8–9 servings per day) lowered SBP by 5.5 mm Hg and diastolic BP by 3 mm Hg compared with a typical American diet, whereas a diet high in fruits and vegetables alone (without dairy products and other aspects of the DASH diet) was approximately half as effective (−2.7 mm Hg SBP and −1.9 mm Hg diastolic BP).[56]

Finally, some[43,44,59] but not all[41,42,60–62] clinical studies have shown that dairy product consumption resulted in reduced body fat—specifically abdominal fat, a key risk factor for IRS. Results in obese adults on calorically restricted diets for 12 weeks[59] and 24 weeks[42,43] that included 3 servings of mostly low-fat dairy products showed enhanced losses of body weight ($P < 0.01$), trunk fat ($P < 0.01$), and waist circumference ($P < 0.001$) compared with a low-calcium/low-dairy calorie-restricted diet. Other studies, however, have not observed significant differences in body weight and fat loss under energy restriction in obese or overweight adults consuming low-moderate versus high-dairy diets,[42,60] low versus high calcium/dairy,[41,61] or calcium plus vitamin D supplements versus placebo.[62] Additional studies are needed to identify dietary and/or nutritional factors that could help elucidate these inconsistencies, which may involve interactions of baseline calcium intakes, BMI, and caloric restriction.

Summary

Taken collectively, nutrient intake data indicate that the 2005 DGA recommendation of 3 servings per day from the milk group is the minimum amount necessary to ensure adequate intakes of calcium for all Americans older than 9 years, whereas 4 servings per day may be necessary to ensure adequate intakes of magnesium and potassium. There is strong and consistent evidence that diets containing adequate levels of calcium and vitamin D and possibly other nutrients provided by the MyPyramid Food Guidance System that include 3 daily servings of milk products are protective against low bone mass and osteoporosis. Additional data are needed to resolve inconsistencies on the role of calcium, vitamin D, and dairy foods in fracture prevention. Emerging, albeit limited, evidence suggests that calcium, vitamin D, and milk product intake may help protect against IRS and its components. Because IRS and t2DM are highly prevalent in the United States, even modest reductions in risk factors may substantially lower the disease burden in the population. In light of the public health need to ensure adequate nutrient intakes by all Americans to optimize growth and development and to reduce the risk of chronic disease, maximizing the intake of nutrient-rich foods such as dairy, fruits, vegetables, and whole grains within calorie needs, along with improving healthy lifestyles, should be a priority consideration for future dietary guidelines.

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Steroids Not as Effective in Obese Patients With Asthma

Glucocorticoids, the primary controller medication for asthma, are 40% less effective in overweight and obese patients with asthma than in those of normal weight, according to researchers at National Jewish Health in Denver.

Nearly half of the people who have asthma are classified as either overweight or obese, with a body mass index greater than 25 kg/m^2. An increasing body of literature suggests a connection between obesity and asthma. Obese people often have higher levels of inflammatory molecules in their bodies; asthma is characterized in part by inflamed airways. Studies suggest that being overweight or obese increases asthma incidence and makes asthma more difficult to control.

The study sought to understand why glucocorticoids, commonly called steroids, might be less effective in overweight and obese patients with asthma. They enrolled 45 nonsmoking adults, 33 of whom had asthma, and measured the response of cells in the blood and the lungs to the steroid dexamethasone.

Steroids interfere with inflammatory signaling pathways by raising the level of a molecule known as Mitogen-activated protein (MAP) kinase phosphatase-1 (MKP-1). When the researchers applied the steroid dexamethasone to cultures of the participants' blood cells, they found that steroids did not increase MKP-1 as effectively in overweight and obese patients with asthma when compared with lean patients with asthma.

Dexamethasone increased the levels of MKP-1 by more than 5 times in cultured blood cells from lean asthma patients, whereas MKP-1 levels in overweight and obese patients with asthma increased by only 3 times. The heavier a person was, the less his/her cells were likely to respond to dexamethasone. This negative relationship between weight and response to steroids did not occur in participants who did not have asthma.

Previous studies have suggested a link between weight and response to steroids in patients. This study suggests a potential mechanism by which this occurs. The researchers caution that inhaled steroids are still effective in overweight and obese patients with asthma, and if patients are concerned that their asthma control medication is not working, they should discuss this with their physician rather than simply quit taking their medication or increasing their prescribed dosage. Source: *American Journal of Respiratory and Critical Care Medicine*

Caffeine Experts Call for Warning Labels for Energy Drinks

Scientists who have spent decades researching the effects of caffeine report that a slew of caffeinated energy drinks now on the market should carry prominent labels that note caffeine doses and warn of potential health risks for consumers. The caffeine content of energy drinks varies over a 10-fold range, with some containing the equivalent of 14 cans of Coca-Cola; yet the caffeine amounts are often unlabeled, and few include warnings about the potential health risks of caffeine intoxication. Over-the-counter drugs with large amounts of caffeine in them that are used by some people to stay awake require such labeling.

The market for these caffeinated drinks stands at an estimated $5.4 billion in the United States and is expanding at a rate of 55% annually. Advertising campaigns, which principally target teenagers and young adults, promote the performance-enhancing and stimulant effects of energy drinks and seem to glorify drug use. Without adequate, prominent labeling, consumers most likely will not realize whether they are getting a little or a lot of caffeine. According to the researchers, "It's like drinking a serving of an alcoholic beverage and not knowing if its beer or scotch."

A regular 12-oz cola drink has about 35 mg of caffeine, and a 6-oz cup of brewed coffee has 80 to 150 mg of caffeine. Because many energy drinks are marketed as "dietary supplements" and not as beverages, the limit that the Food and Drug Administration requires on the caffeine content of soft drinks (71 mg per 12-oz can) does not apply. The caffeine content of energy drinks varies from 50 mg to more than 500 mg.

Reports to US poison control centers of caffeine abuse showed bad reactions to the energy drinks. In a 2007 survey of 496 college students, 51% reported consuming at least 1 energy drink during the last month. Of these energy drink users, 29% reported "weekly jolt and crash episodes," and 19% reported heart palpitations from drinking energy drinks. This same survey revealed that 27% of the students surveyed said that they mixed energy drinks and alcohol at least once in the past month. Source: *Drug and Alcohol Dependence*